REMARKS

In accordance with the foregoing, claims 15 and 17-19 are amended. No new matter is added. Claims 16 and 20-25 are cancelled without prejudice and disclaimer of the subject matter. Claims 15, and 17-19 are pending and under consideration.

CLAIM REJECTIONS UNDER 35 U.S.C. §112

In numbered paragraph 3 of the outstanding Office Action, claims 15-25 are rejected under 35 U.S.C. §112, second paragraph. Claim 15 is rejected because it is considered that further clarifications regarding the manner in which the food is brought in contact with the sintered Ti-modified calcium hydroxyapatite is necessary.

Applicant submits that the rejection under 35 U.S.C. §112 is improper. However, in an effort to expedite prosecution, claim 15 is amended herewith to include the features previously recited in claim 16, and claims 17-19 are amended to include the features originally recited in claim 15. Thus, each of the independent claims 15 and 17-19 now specifies the manner in which the food is brought into contact with the sintered Ti-modified calcium hydroxyapatite. In view of the claim amendments, Applicants respectfully request that the rejection under 35 U.S.C. §112 of claims 15-19 be withdrawn.

The cancellation (without prejudice and disclaimer of the subject matter) of claims 20-25 renders moot the rejections under 35 U.S.C. §112 directed to claims 20-25.

CLAIM REJECTIONS UNDER 35 U.S.C. §102

In numbered paragraph 5 of the outstanding Office Action, claims 23 and 25 are rejected under 35 U.S.C. §102(b) as allegedly being anticipated by JP 2000-3273315 to Wakamura et al. (hereinafter "Wakamura"). In numbered paragraph 6 of the outstanding Office Action, claim 23 is rejected under 35 U.S.C. §102(b) as allegedly being anticipated by JP 63023744 to Shimazaki et al. ("Shimazaki").

The cancellation (without prejudice and disclaimer of the subject matter) of claims 20-25 renders moot the rejections under 35 U.S.C. §102 directed to claims 23 and 25.

CLAIM REJECTIONS UNDER 35 U.S.C. §103

In numbered paragraph 9 of the outstanding Office Action, claims 15-18 and 20-25 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over:

1. U.S. Patent 5,658,530 to Dunn (hereinafter "Dunn") in view of

2. Wakamura,
3. U.S. Patent No. 5,614,568 to Matawari et al. ("Matawari"),
4. U.S. Patent No. 4,367,312 to Bontinck et al. ("Bontinck"),
5. U.S. Patent No. 6,004,667 to Sakurada et al. ("Sakurada"),
6. JP03275627 to Saito ("Saito"),
7. JP2000-095577 to Hiraide et al. ("Hiraide"),
8. Shimazaki,
9. U.S. Patent No. 5,468,489 to Sakuma et al. ("Sakuma"),
10. JP04170960 to Atsumi et al. ("Atsumi1"), and
11. JP04217902 to Atsumi ("Atsumi2").

Amended independent claims 15 and 17-19 specify that in the prepared Ti-modified calcium hydroxyapatite "a part of calcium in calcium hydroxyapatite is substituted with titanium." The above-identified added language aims to remove any confusion between the claimed Ti-modified calcium hydroxyapatite and a complex of calcium hydroxyapatite and a metal oxide.

Further, amended independent claims 15 and 17-19 specify that the sintering the Ti-modified calcium hydroxyapatite at 580 to 660°C aims to "[enhance] photocatalytic activity of the Ti-modified calcium hydroxyapatite". This added language aims to clarify the intended function of the "sintering" at 580 to 660°C. Although functional language, the feature is regarded as a distinguishing feature in a method claim, as opposed to a process feature in a product claim, thereby removing the basis of an alleged motivation to combine the teachings of some of the prior art references.

The claimed methods (see amended independent claims 15 and 17-19) take advantage of that the antibacterial effect (which is based on the photocatalytic activity) of Ti-modified calcium hydroxyapatite (abbreviated as "Ti-CaHAP") is unexpectedly enhanced by preliminary sintering at 580 to 660°C. This unexpected result is experimentally supported by Examples 3 and 4. Note that sintered Ti-CaHAP (A3 in Figure 3: storage under light exposure; A4: storage without light exposure) provides a higher antibacterial effect than non-sintered Ti-CaHAP (A1: storage under light exposure; A2: storage without light exposure), in spite of the fact that Ti-CaHAP is otherwise the same in Examples 1-4.

As admitted in the Office Action, Dunn only discloses a titanium dioxide (TiO_2) as a

catalyst but fails to teach or suggest Ti-modified calcium hydroxyapatite.

Wakamura discloses Ti-modified calcium hydroxyapatite, but Ti-CaHAP is heated only to 100°C (see Paragraphs 0019 and 0021), which is far less than the claimed temperature range of 580 to 660°C. Further, this document also does not teach or suggest the use of Ti-CaHAP for food preservation.

Mawatari does not refer to Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium. Mawatari merely mentions calcium hydroxyapatite as an example of support for a metal catalyst such as silver (column 7, lines 25-49). Further, sintering or calcination (at 800°C) in Mawatari et al is performed only for strengthening the bonding of silver on the calcium hydroxyapatite support (column 7, lines 43-9), but not for enhancing the photocatalytic activity.

Similarly, Bontinick does not refer to Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium. Therefore Bontinick also fails to provide any relevant teachings relative to sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Sakurada merely teaches combination of a photocatalytic film made of e.g. TiO_2 with an adsorbent such as hydroxyapatite (column 6, lines 49-63). Thus, Sakurada fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium. Thus, Sakurada also fails to provide any relevant teachings relatinve to sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Sakurada merely teaches a combination of photocatalytic powder (e.g. TiO_2), metal powder (e.g. gold, silver) and an adsorbent material such as hydroxyapatite (abstract). Thus, Sakurada fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Saito teaches replacing the metal ion on apatite with an antimicrobial metal and sintering at 600°C (or at a temperature no less than 300°C). The examples of antimicrobial metal include Ag, Cu, Zn, Sn, Hg, Pb and Cd only. In the actual examples tested in Saito, only Ag and Cu were tested as antimicrobial metal (see table 1). Further, the sintering at a temperature no less than 300°C is performed only for firmly fixing the metal ion, not for enhancing the photocatalytic activity. Thus, Saito, also fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and sintering of Ti-CaHAP at 580 to 660°C for

enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Hirade merely teaches a complex of hydroxyapatite (element 4a in Figure 2) with titanium (element 4b inside element 4a). Hirade also fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Shimazaki merely teaches a mixture of hydroxyapatite (partially substituted with an alkali metal or alkali earth metal) and an oxide or composite oxide of an element selected from Mg, Sr, Ba, B, Si, P, Ti, Zr, Nb, Mo, Ta, W, Bi and Co (abstract). Thus, Shimazaki also fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Atsumi1 merely teaches Ag and Zn for combination with calcium hydroxyapatite, and a sintering temperature as high as no less than 800°C (see the English abstract). Thus, Atsumi1 also fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Similarly, Atsumi2 merely teaches the use of Ag, Cu, Zn and Ni in combination with calcium hydroxyapatite, and a sintering temperature as high as no less than 800°C (see the English abstract). Thus, Atsumi2 also fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Sakuma merely teaches dentrifrice (tooth paste or powder) that comprises calcium hydroxyapatite supporting or combining with an antibacterial metal. However, enumerated examples of antibacterial metal includes Ag, Zn and Cu only. Further, Sakuma discloses a sintering temperature of no less than 800°C (column 2, lines 25-49) which is far higher than the claimed range, as admitted in the Office Action. Sakuma also fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

The Office Action argues combining the prior art references using an improper hindsight reconstruction. None of the cited documents suggest that the photocatalytic activity of Ti-CaHAP (in which a part of calcium is substituted with titanium) is particularly enhanced by sintering at 580 to 660°C.

In view of the above discussion of the prior art references' teachings, amended independent claims 15, and 17-19 patentably distinguish over the prior art at least by reciting:

- preparing Ti-modified calcium hydroxyapatite in which a part of calcium in calcium hydroxyapatite is substituted with titanium;
- sintering the Ti-modified calcium hydroxyapatite at 580 to 660°C for enhacing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

In numbered paragraph 10 of the outstanding Office Action, claim 18 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over the references listed in numbered paragraph 9 and AGAIN Sakuma. Since Sakuma's teachings are discussed above, Applicant respectfully submits that no new arguments are made necessary by this additional rejection.

In numbered paragraph 11 of the outstanding Office Action, claim 19 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over the references listed in numbered paragraph 9 and JP2000-051041 to Okamoto ("Okamoto").

Okamoto merely teaches titanium dioxide (TiO_2) as a catalyst, but fails to teach or suggest Ti-CaHAP in which a part of calcium in calcium hydroxyapatite is substituted with titanium, and the sintering of Ti-CaHAP at 580 to 660°C for enhancing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

Thus, since Okamoto does not correct or compensate for the above-identified failure of references listed in numbered paragraph 9 to render obvious all the features of the independent claims, the amended independent claim 19 patentably distinguishes over the prior art.

In numbered paragraph 12 of the outstanding Office Action, claims 15-17 and 20-25 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Wakamura, in view of Saito, Hiraide, Shimazaki, Atsumi1, Atsumi2, Dunn, Mawatari, Bontinck, Sakurada and JP 11343210 to Sakurada ("SakuradaJP").

Applicant found no evidence that SakuradaJP corrects or compensates for the above-identified failure of the above-discussed prior art references to render obvious all the features recited in the amended independent claims. Therefore, Applicant reiterates that amended independent claims 15, and 17 patentably distinguish over the prior art at least by reciting:

- preparing Ti-modified calcium hydroxyapatite in which a part of calcium in calcium hydroxyapatite is substituted with titanium;
- sintering the Ti-modified calcium hydroxyapatite at 580 to 660°C for enhacing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

In numbered paragraphs 13 and 14 of the outstanding Office Action, claims 18 and 19 appear to be rejected over the references listed in paragraph 12[1], and, in addition, Sakuma and Okamoto, respectively. Applicant found no evidence that the additionally cited references correct or compensate for the above-identified failure of the prior art references cited in paragraph 12 to render obvious all the features recited in the amended independent claims. Thus, Applicant reiterates that amended independent claims 18, and 19 patentably distinguish over the prior art at least by reciting:

- preparing Ti-modified calcium hydroxyapatite in which a part of calcium in calcium hydroxyapatite is substituted with titanium;
- sintering the Ti-modified calcium hydroxyapatite at 580 to 660°C for enhacing photocatalytic activity of the Ti-modified calcium hydroxyapatite.

CONCLUSION

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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[1] Applicant respectfully requests the Examiner to review the rejections which are confusing since both paragraphs 13 and 14 refer to "above in paragraph 14"!